CLAIMS:

1. A method for anisotropically etching a Cu-containing layer comprising the steps of:

providing a Cu-containing layer overlying a substrate;

introducing a directional beam of neutral oxygen atoms having high kinetic energy;

oxidizing the Cu-containing layer by exposure to the beam of oxygen atoms;

introducing a reagent capable of forming volatile etch products when reacted with the oxidized Cu-containing layer;

removing the etch products from the Cu-containing layer.

2. The method according to claim 1, wherein the reagent comprises a β-diketone gas.

3. The method according to claim 2, wherein the β-diketone gas comprises at least one of acacH, tfacH, and hfacH.

4. The method according to claim 1, further comprising introducing an inert gas.

5. The method according to claim 4, wherein the inert gas comprises at least one of argon, helium, xenon, and nitrogen.

6. The method according to claim 1, wherein the substrate is maintained at a temperature below 200°C.

7. The method according to claim 1, wherein the substrate is maintained at a temperature below 150°C.

8. The method according to claim 1, wherein the substrate is maintained at a temperature below 100°C.

9. The method according to claim 1, wherein the neutral oxygen atoms have kinetic energy between 10eV and 1eV.

10. The method according to claim 1, wherein the neutral oxygen atoms have kinetic energy between 100eV and 10eV.

11. The method according to claim 1, wherein the neutral oxygen atoms have kinetic energy in excess of 100eV.

12. A processing system for etching Cu-containing layers comprising:

a process chamber;

a source of a directional beam of neutral oxygen atoms having high kinetic energies;

a gas injection system configured to inject a process gas into the process chamber, wherein the process gas comprises a reactant gas;

a substrate holder, the substrate holder exposes a substrate comprising a Cu-containing layer to the source of neutral oxygen atoms and the reactant gas; and

a controller that controls the processing system.

13. The system according to claim 12, wherein the source of a directional beam of neutral oxygen atoms comprises a RF source.

14. The system according to claim 12, wherein the source of a directional beam of neutral oxygen atoms comprises a laser-induced discharge source.

15. The system according to claim 12, wherein the neutral oxygen atoms have kinetic energies between 100eV and 10eV.

16. The system according to claim 12, wherein the neutral oxygen atoms have kinetic energies between 10eV and 1eV.

17. The system according to claim 1, wherein the neutral oxygen atoms have kinetic energies in excess of 100eV.

18. The system according to claim 12, wherein the reactant comprises a β-diketone gas.

19. The system according to claim 12, wherein the β-diketone gas comprises at least one of acacH, tfacH, and hfacH.

20. The method according to claim 12, wherein the process gas further comprises an inert gas.

21. The system according to claim 20, wherein the inert gas comprises at least one of argon, helium, xenon, and nitrogen.